Assessment of Electromechanically Stimulated Bone Marrow Stem Cells Seeded Acellular Cardiac Patch in a Rat Myocardial Infarct Model

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Abstract

Although substantial progress has been made in tissue engineered cardiac patch, the translation of such strategies into a clinical setting has always face setbacks due to the lack of appropriate scaffolds and cell resources. Here, we evaluated cardiomyogenic differentiation of electromechanically stimulated rat bone marrow-derived stem cell (rt-BMSCs) on an acellular bovine pericardium (aBP) as well as the performance of this engineered patch in a rat myocardial infarct (MI) model. Briefly, aBP was prepared using a detergent-based decellularization procedure. The formed aBPs were seeded with rt-BMSCs and then stimulated under electrical, mechanical or electromechanical conditions (3-millisecond pulses of 5 V/cm at 1 Hz, 5% streching) to enhance cardiomyogenic differentiation. Thereafter, electromechanically stimulated patch was applied on MI region over a time period (3 weeks). After this period, the retrieved patch and infarct region were evaluated in terms of calcification, inflammatory reaction (CD68), cell migration from patch to host tissue and sarcomere structure related protein expressions. Patch related calcification was not examined in all tested group. Moreover, higher number of BrdU-labelled cells and low level of CD68 positive cells were observed in the infract region under electromechanically stimulated conditions as compared with static conditions. More importantly, MHC, SAC, Troponin T and N-cad positive cells were observed in both infarct region and retrieved engineered patch after the 3 weeks. As a result, we showed that a noticeable differentiation of stem cells on an acellular patch into cardiomyocytes under the electromechanical stimulation. This patch successfully integrated with the host tissue via cell migration from the patch to the infarct region.

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